posterior limbs, and the shoulder-blades thrown up from their proper position some distance above the line of the vertebral column. The skull is almost entire, and although the scapulæ are imperfect, and the right pectoral limb has sustained some losses, all the bones of the skeleton are in their original juxtaposition, so that we may note the arrangement of the bones of the carpus or tarsus almost as well as in the skeleton of a recent type. It strikes us, indeed, that it would have been quite easy to have extracted the skull and many of the bones of the limbs from the matrix, and made entire casts from them, which could have been placed in cavities in the cast from the original slab.

The chief importance of this and other American specimens of fossil Mammals belonging to totally extinct types is their completeness, whereby we are enabled at once to gain a very fair idea of the affinities of the animals to which they belonged. In Europe, with the exception of the well-known Mammals of the Upper Eocene (or Lower Oligocene) of the Paris basin, our efforts are nearly always hampered by the imperfect nature of our specimens—as witness the question whether the limb-bones from Hordwell described by Kowalewsky are or are not referable to the *Dichodon* of Owen, which was founded upon the evidence of the skull—so that we can very rarely speak confidently and fully as to the affinities of any particular form. It may, indeed, be stated, without any fear of contradiction, that we could never have hoped to have attained anything like our present knowledge as to the mutual affinities of the various sub-orders (or orders) of Ungulate Mammals and their relations to other groups, had it not been for the fortunate discoveries of such a host of well-preserved specimens in the Tertiaries of the United States. And we may here express the obligations which all European students are under to those palæontologists who, like Messrs. Cope, Leidy, Marsh, Osborn, Scott, and others, have laboured so indefatigably to collect and describe the Vertebrate faunas of past epochs in the so-called New World. In expressing thus briefly our obligations to these eminent exponents of the life-history of a former world, we must, however, not omit also to mention the enlightened liberality of the Government and of various learned Societies in the States, which have furnished the funds necessary to render these treasures available to the world, through the means of the magnificent publications in which they are described.

In concluding this brief notice of the new treasure recently aquired by our National Museum, we may say a few words regarding some of the chief characters of the Condylarthrous Ungulates. One of their most essential features is the comparatively simple arrangement of the bones of the wrist and ankle joints (carpus and tarsus); the various rows preserving their original distinction, and having only very slight mutual interlocking. In this respect, this group agrees with the existing Hyracoidea so closely that Prof. Cope has considered himself justified in brigading the two groups together under the common title of Taxeopoda. Usually the dentition comprises the full number of teeth found in those higher, or placental, Mammals in which the teeth are differentiated into groups; and very generally the cheek-teeth have their crowns formed on what is known as the bunodont type. That is to say, their crowns are low, and carry three or more low and blunt tubercles, as exemplified in the pig and in man. Further, the eye or canine teeth are well developed, and recall those of the Carnivora. Again, the humerus, or bone of the upper arm, has a foramen at its lower extremity, which is totally unknown in all other Ungulates, and likewise recalls the Carnivora and some of the lower orders. The digits are nearly always five in number, and their terminal joints are so pointed as frequently to render it difficult to say whether their coverings should be termed nails or hoofs. The femur, or leg-bone, has a third trochanter, like that of existing Perissodactylate Ungulates; and the ankle-bone, or astragalus, has its lower articular surface uniformly convex, instead of flattened or facetted as in all modern Ungulates. The astragalus and the wrist joint are, indeed, very similar to the same parts in the generalized Carnivora of the Eocene. The tail was larger and heavier than in any existing Ungulate, and was thus more like that of many Carnivora, such as the wolf. In walking, it appears that the three middle toes of each foot touched the ground, whilst the first and fifth toes stuck out on the sides and behind, after the fashion obtaining with the second and fifth toes of the pigs.

The curious approximation made in the osteology of this remarkable type of Mammal to the generalized Carnivora of the Eocene, to which Prof. Cope has applied the name of Creodonta, is so marked that Dr. Max Schlosser, of Munich, considers that we are now justified in regarding the Ungulates and the Carnivores as divergent branches of a single primitive stock. *Phenacodus* is regarded, moreover, by Prof. Cope, as the ancestral type from which a number of the more specialized Ungulates have been derived; and there appears every probability that this genus should be placed as one of the earlier links in the chain which culminates in the modern horse.

Recently, however, the American Professor has proposed to include in the Taxeopoda not only the Hyracoidea and Condylarthra (which it was originally formed to receive), but also the Primates of English zoologists, which it is proposed to divide into the Daubentoidea, represented by the existing aye-aye (*Chiromys*) and the extinct *Mixodectes*; the Quadrumana, embracing the other lemurs and monkeys; and the Anthropomorpha, which is taken to include the man-like apes and man. A complex genealogical tree is given, in which the *Phenacodontidæ* are represented as not only the progenitors of the other Ungulates, but also as giving origin on the one hand to the so-called Daubentoidea, and on the other to the Quadrumana, from which the Anthropomorpha are derived as a secondary branch from the Eocene Lemuroid *Anaptomorphidæ*, which group is itself derived from the *Adapidæ*, as represented by the well-known *Adapis* of the Upper Eocene of Europe.

Now, with all due respect to Prof. Cope, we venture to say that no English zoologist will be inclined to accept a classification which includes in a single "order" such widely different forms as man and the hyrax, while the other Ungulates are apparently regarded as constituting a totally distinct order. Again, in regard to the genealogical tree it appears to us to be incomprehensible how an order like the Primates, all the members of which are furnished with fully-developed clavicles, can have taken origin from an Ungulate type like *Phenacodus*, in which it appears that those bones are totally wanting. While, therefore, fully recognizing the great interest of *Phenacodus* as an ancestral type, we totally fail to see how it can also be regarded as the "ancestor of lemurs and of man." R. L.

THE IRON AND STEEL INSTITUTE.

THE twentieth session of the Iron and Steel Institute was opened on Wednesday, May 8, when the President, Sir James Kitson, gave his inaugural address, which was of a technical character, and was devoted mainly to the consideration of the best Yorkshire iron as an industrial product; but the subject of iron alloys, to which we shall refer again, the extending application of iron and steel for railways and ships, and other matters of interest, such as technical education and the revival of trade, were also referred to.

The first paper read was one on the alloys of nickel and steel, by Mr. James Riley. This led to a very lengthy and interesting discussion, from which it appeared, as has

© 1889 Nature Publishing Group

often occurred in similar instances, that another metallurgist had been working in the same direction for a considerable time. The results obtained by Mr. F. J. Hall, of Messrs. Jessop's, of Sheffield, and Mr. Riley are very similar in character, but whilst the former appears to have made what may be called industrial experiments, those of the latter have been mainly confined to the laboratory. Nickel can be made to form an alloy with steel, in quantities varying from a hardly appreciable amount up to as much as 50 per cent.: the alloy does not require an excessively high temperature to melt it, special attention is not necessary in its production, the resulting metal is definite in character, and is easily worked both under the hammer and in the rolls. A very remarkable increase in the tensile strength and elasticity of steel is produced by alloying it with nickel. Among many tests given by Mr. Riley, the following specially referred to by him may be cited:—"In No. 6, the carbon present (0·22) is low enough to enable us to make comparison with ordinary mild steel, which would give (when annealed) results about as follows: elastic limit, 16 tons, breaking strain, 30 tons, extension 23 per cent. on 8 inches, and contraction of area 48 per cent. Therefore, in this case the addition of 4·7 per cent. of nickel has raised the elastic limit from 16 up to 28 tons, and the breaking strain from 30 up to 40·6 tons, without impairing the elongation, or contraction of area to any noticeable extent." In his remarks Mr. Hall referred to his applications of nickel steel to gun barrels, propeller blades, and other purposes during recent years, and concluded by observing that in an experiment he had made about twelve months ago, he had obtained with nickel steel a tensile strength of 97 tons per square inch, with an elongation of 7 per cent. Another important point with regard to nickel steel referred to by Mr. Riley is its non-corrosibility when the alloy contains 25 per cent. of nickel, for, with low proportions of nickel, ordinary mild steel and nickel steel appear to corrode in about the same proportion. In the discussion Mr. White (the Chief Constructor of the Navy) drew attention to the question of cost, as affecting the application of materials in practice, and with nickel at £224 a ton, or £56 as the cost of the nickel in a ton of 25 per cent. nickel steel, it is a consideration.

The next paper, on the manufacture of basic open-hearth steel, by Mr. J. H. Darby, also gave rise to an important discussion. From the paper and discussion it may be inferred that the basic steel industry has not made so much progress in this country as it has done in Germany. This may be due to the circumstance that German ores are mainly phosphoric in character (Mr. Thielen, who spoke as to his experience in Germany, stating that of the steel now produced in the Siemens furnace in Germany 70 or 80 per cent. was produced in the Siemens basic furnace), or to the "Batho type" of furnace used in this country being inapplicable to steel-making, an opinion expressed as well by the author of the paper as by speakers who followed him. Mr. Windsor Richards could not understand why they had gone away from the rectangular furnace of Sir William Siemens, and was pleased to say that since he had returned to it his difficulties had come to an end; whilst Mr. John Head, Mr. Frederick Siemens's representative, spoke of a new form of regenerative gas furnace, recently built and tried, which consumed about 50 per cent. less coal than the original regenerative gas furnace, and promised a paper on the subject for the autumn Paris meeting of the Institute.

A statistical paper on the progress made in the German iron industry since 1880 was read by Mr. R. Schroedter.

One on the influence of copper on the tensile strength of steel was read by Messrs. E. J. Ball and A. Wingham, in which the authors state that from a general consideration of the results of their experiments it would seem that within certain limits copper does not prejudicially affect the mechanical properties of steel. In this they agree with a theory brought by Prof. Roberts-Austen before the Royal Society last year to the effect that small quantities of a metallic impurity exert a deleterious effect on a large mass of another metal only if the atomic volume of the impurity is greater than that of the metal in which it is hidden. Mr. Bauerman, in discussion, expressed the opinion that it was not the copper, but the sulphur which generally came with the copper, that was injurious to iron.

The papers on universal rolling-mills for the rolling of girders and cruciform sections, by Mr. H. Slack, and on the Thomasset testing-machine, by M. Gautier, were mainly of mechanical interest. M. A. Pourcel read a paper on the application of thermal chemistry to metallurgical reactions.

ROBERT STIRLING NEWALL, F.R.S.

OBSERVANT travellers by the Great Northern Scotch express may see, as it nears Newcastle, the low dome of an astronomical observatory on the eastern side of the line. It is a spot which will be memorable in the history of astronomy, and it marks the home of a man who combined the practical sagacity and inventive skill which have made England the first industrial nation in the world, with the love of science which must be added to these if it is to hold its place.

Mr. Newall, whose death we chronicled a fortnight ago, was a successful manufacturer. When he was still a young man, a friend who was studying mining in Saxony informed him that cables made of iron wires were largely used there, but that the process of making them was "unmechanical," and suggested that he should invent a machine for the purpose. This he did, and wire ropes of his construction are now used all over the world. From time to time he improved on the original design, and so lately as 1885 he devised a new machine by which the rope is made at one operation, the double process of first making the strands and then combining them being avoided.

His interest in his business was not, however, confined to the gradual development of his earlier patents. He was quick to see that wire rope might help in solving the difficulties which had to be overcome before submarine telegraphy was an accomplished fact.

Sir Charles Wheatstone had clearly conceived the possibility of electric communication between England and the Continent as early as 1837. In 1840 he gave evidence on the subject before a Committee of the House of Commons, and references were made to his suggestion in the public Press. His drawings and notes show, however, how difficult the problems of insulating and preserving the cables seemed to these early pioneers.

The insulation was attained by the use of gutta-percha—of which Mr. Newall received a portion of the first sample transmitted to this country—but the cumbrous devices at first suggested for protecting the outer covering of the cable were forgotten when Mr. Newall proposed that the "gutta-percha lines containing insulated wire should be surrounded with a strong wire rope" (pamphlet by Mr. R. McCalmont, dated September 19, 1850).

The first cable, laid between Dover and Cape Grisnez, in which this plan was not employed, broke after one day. The first successful cable, which was laid on September 25, 1851, by Mr. Crampton, was manufactured by Mr. Newall, and protected by wire.

The submergence of cables in seas deeper than the English Channel presented greater difficulties, and the Newall drum-brake, which was introduced in 1853, and afterwards for a time abandoned, has since been again employed, so that, as Mr. F. C. Webb stated at the Institute of Telegraph Engineers in 1876, "we have come back to the old drum-brake of Newall."

© 1889 Nature Publishing Group